**GSICS Annual Meeting: Microwave Subgroup Meeting**

**1100-1300 UTC October 28, 2021**

**Attendees:**

CMA: Qifeng Lu, Wu Shengli

Hamburg University: Martin Burgdorf

JAXA: Misako KACHI

NASA: Rachel Kroodsma

NOAA: Mark Liu, Robbie Iacovazzi, Ninghai Sun, Cheng-Zhi Zou

UMD: Jun Zhou, John Xun Yang

**1.** **Opening Remarks (Quanhua “Mark” Liu, NOAA)**

No remarks … led directly into the presentations.

**2. [30 mins] A new algorithm for determining NEDT of microwave radiometers (John Xun Yang – U. of Maryland)**

Discussed the development of a new algorithm for determining NEDT for microwave radiometers, and contrasted the method versus NEDT estimation methods from the major numerical weather prediction centers.

*Questions and Answers*

*Mark*

* Do you use current orbital thermal variation or previous orbital therma variation history in computing NEDT?
  + Orbit variation removed using onboard PRT measurement, and that measurement captures variation. When we derive NEDT we get warm-load noise. Once we get the warm-load noise any drifts can be accounted for in computing NEDT.
* Do you need a whole orbit of data? Operationally we use several scan lines.
  + Don’t need a full orbit, can have a quarter orbit as long as you have PRT temperature. Half an orbit of data can be used.
* In operations, we assume effects of white noise and 1/f for microwave sensor. Do you include 1/f noise? Striping and channel-to-channel covariance can be caused by 1/f noise.
  + In the simulation, the 1/f and white noise are included. In the new algorithm, 1/f noise can be dealt with very well.
* Can you separate 1/f noise from white noise?
  + Yes, but it depends on some things, e.g., signal to noise ratio.
  + If we want to separate these, the noise has to be significant enough.
  + If noise is pronounced enough, then yes. If small, then can be masked out by the scene temperature. Very difficult to separate the two noise effects when noise is small.

*Shengli*

* All the data in your method uses the warm load. Did you use the cold target? Also, you used the vacuum test results, but the on-orbit space environment is different. Which one is truth?
  + Cold space count used as well. There is some minor difference in terms of noise. Warm load noise is larger by 20% compared to cold space noise. The signal to noise is very high so can separate thermal and 1/f noise. There is no difference in percentage of thermal and 1/f noise between warm and cold targets. The magnitude of the noise increases slightly.
  + Use TVAC measurement. We choose the one the has the closest environment to the in-orbit space environment. We did experiment with other TVAC environments, and those results were not significantly different.
* During TVAC, is the warm load you use is the same as the sensor warm load?
  + Yes, they are the same. We don’t use the external warm load.

*Robbie*

* My belief has been that typically on-orbit noise performance is better than what is measured in TVAC. Is it safe to say that your paper suggests that we been underestimating on-orbit noise?
  + Yes … we show that. No for all channels though. This underestimation is less likely with the new method.

*Cheng-Zhi*

* Have you applied the new algorithm to the older satellite, like N15 AMSU/MHS? These instruments have a lot of temperature variation. ATMS uses NOAA algorithm, but NEDT for the old satellite can change. Might these NEDT variations be caused by the errors you mention in your talk, or is there a real variation?
  + We have not applied this method to these data. Our algorithm is general and can be applied to any instrument. Might be good to dig into.

*Qifeng*

* Could you demonstrate that your algorithm could be used as a unified, or best-practice”, algorithm? Currently, agencies use different algorithms to determine instrument performance. We don’t have a best practice method. Can you take an action to demonstrate a best-practice noise computation method? Can we agree as a community in how we compute NEDT?
  + ACTION: Robbie will provide the paper to the group.
  + This work shows how the algorithm works well, and it shows how it can be applied to any microwave radiometer. It can better represent NEDT, and help us monitor NEDT in a better way. We are interested in seeing how our method may be applied other sensors. You are welcome to read my slides and paper, and it is fine if you have questions about it.

**3. [30 mins] Improving ATMS Remapping Accuracy Using Adaptive Window Method (Jun Zhou – U. of Maryland)**

This study presents an implementation of Backus-Gilbert Inversion (BGI) microwave data remapping algorithm using an adaptive instead of fixed remapping window. This approach of using the adaptive remapping window is shown to reduce scan-dependent remapping noise changes.

*Mark*

* Can you make the new remapping code available to the group to determine if there is a benefit for their remapping efforts. Most NWP centers and the MiRS are using APP code.
  + We can provide coefficients and adaptive window coefficients. We have not published this work yet, and are sensitive to code release. Maybe after the work is published.
* You have enhanced the ATMS Channel 1 and 2 footprints from 5.2 deg to 3.3 deg. Have you tried to enhance them to 2.2 deg.?
  + Do you mean 1.1 deg? No answer.
  + BGI achieves resolution at the cost of increased noise, so it would be difficult to perform such enhancement without a large increase in noise. We could try the experiment though to see what happens.

*Qifeng*

* Did you do some test with respect to NWP center remapping? ECMWF maps ATMS data in 3X3 subsets, and for Metop AMSU data in 2x2 subsets to reduce noise. It is a better fit for O-B. Did you do some test or have communication with that community?
  + The NWP centers use various reconstruction methods. We could suggest that they use the adaptive window method. We do want to use ATMS adaptive window resampling in the MiRS. We will communicate with ECMWF and other centers using BGI with a fixed window.
* You are using scan-dependent or adaptive window? NWP centers tend to perform scan angle correction because of optical path is a function of scan angle. Will your new algorithm will have less bias across scan angles? How will your method effect this scan bias removal process in NWP? It would be good to have feedback from NWP centers.
  + BGI algorithm is a preprocessor before any scan angle dependent correction. Scan-dependent bias correction requires stable noise across the scan. Our method will help that.
  + Want to see if both talks are applicable to NWP centers. For next year, we can work out with the community to work with their algorithms.

*Mark*

* The two talks today covered new methods to compute NEDT and to flexibly choose remapping windows. Each of these talks provides a potential for the group
  + ACTION: The subgroup is to consider for next year to support activities related to helping the NWP centers to test these new methods in their system.

**4. Subgroup Action Item Review (Mark and Qifeng)**

Plenary Sessions ACTIONS to the Microwave Subgroup

A. (Actionees: Mark and Qifeng) Get in touch with Akihiko to start a potential collaboration with the CEOS WGCV microwave subgroup.

10 June STATUS: Completed. Xiaolong Dong is the WGCV Chair and a mechanism for collaboration is already in place.

28 October STATUS: This has been a two-year collaboration. ACTION: Qifeng will reach out to Xiaolong regarding the GSICS workshop.

B. (Actionees - Mark and Qifeng ) Consider the GRWG desire that the Microwave Subgroup focus on 1) the development of MW GSICS standard products – e.g., O-B and SNO for the microwave sounders, GNSS-RO and microwave imagers, and 2) in the near future the definition of reference instruments and sharing of SNO common codes.

10 June STATUS: Actionees not identified, and completion date not set.

a. Many agencies have or are developing monitoring systems

i. CMA trying to develop system for geolocation of reference instrument, and test instrument to collocate them. They also have O-B Tb, and want to release products.

ii. NOAA has the Integrated Cal/Val System.

iii. Other agencies do similar work.

iv. Want to link statistics to Wiki Page.

v. Want to be able to compare bias correction from other agencies.

vi. Each agency has a point of contact for this. It is Shengli for CMA.

28 October STATUS:

*Qifeng*

* Does JAXA have a MW monitoring system?
  + Misako - JMA has a system. In JAXA there is a Tb monitoring system for internal calibration efforts, but not this monitoring is performed for real-time monitoring and not for public dissemination. But there is a desire to compare with other sensors. Monitoring is done for data assimilation.

ACTION: Misako will check with JMA colleagues to see if monitoring system methods and results can be shared with the GSICS community.

* Does EUMETSAT have a monitoring system for Metop AMSU? If they have a monitoring system, do we get consensus results between NOAA and NASA?
  + Robbie – NOAA monitors NOAA operational microwave instruments. There is no knowledge of EUMETSAT having their own system. They are coming up with their own next generation, so maybe they could talk about this.

*Mark*

* Maybe we can create a paper that contains links to the NWP microwave instrument monitoring pages. May want to poll the group to see if there are sites that
  + ACTION: Robbie to make links on the subgroup wiki to public O-B website, e.g., NOAA EMC, NOAA ICVS, ECMWF, etc.

*Qifeng*

* Shengli, can we provide a status update of our monitoring tools, and publish to results on the web?
  + Shengli –CMA monitoring efforts are in three parts – i.e., O-B, SNO, and Sensor engineering data. The website exists, but the website is not public outside CMA.
* What can be published?
  + Depends on the stability of the input data. For example, SNO dataset cannot be updated quickly because it can take quite a bit of time to get data sources. It is not very stable. ACTION: Shengli to provide a status update of the CMA microwave monitoring systems.

C. (Actionee: Robbie) Get the GDWG presentation so that the group has the links to the GRWG software tools.

10 June STATUS: Not complete and completion date not set.

28 October STATUS: ACTION: Robbie to reach out to Manik for link.

D. (Actionee: Robbie) Steven Maxwell to connect Robbie with the NIST microwave group.

10 June STATUS: Completed. Steven sent Robbie the name and email of Paul Hale from NIST in Boulder.

28 October STATUS: ACTION: Robbie will reach out to Paul Hale.

E. (Actionees: Qifeng and Mark) Action A.GIR.2020319.7 - Manik Bali (NOAA) to review guidance in the definition of time\_coverage\_start and end variables in the GSICS netCDF convention needs to be considered by all Subgroup Chairs.

10 June STATUS: Wait for Manik to make a further request with more detailed information.

28 October STATUS: Can wait for Manik to request the information. ACTION: Robbie to clarify the action with Manik.

F. (Actionee: Robbie) Need to update our action items in the Annual Meeting agenda under the GW Breakout tab.

10 June STATUS: Completed.

G. (Actionee: Robbie to Coordinate with Each MWSG Agency Representative) Add more info about Focal Points – e.g., specialty of individuals - on the Focal Point List in the GSICS WMO Web Site. The process for each GPRC is to contact the GRWG Chair with a list of GRWG members and information about their specialties.

10 June STATUS: Not completed, and no due date set.

28 October STATUS: ACTION: Robbie to reach out to Manik to clarify action, then reach out to MWSG agecy reps if needed.

H. (Actionee: Qifeng and Mark leading the Subgroup) Spectral Response Functions: Subgroups need to consider what spectral response information that they need and what they are willing to work with in terms of formats.

10 June STATUS: Incomplete, and no completion date set.

a. Mark

i. Just released JPSS-2 SRF. Contains frequency and response in dB units or in absolute power.

ii. It is better to have two public release data sets. The public release data that is as close to the original data as possible, and the final version in NetCDF blessed for operational use. The final dataset has been created from the original data, and has been through a screening process using threshold. Sometimes these thresholds may be too strict for certain users.

iii. The original data from the vendor may not be public release, so we must be careful which version of original data that we release.

iv. NetCDF is the NOAA format.

28 October STATUS:

*Mark*

* Do we use ATMS SRF format as a standard? NOAA’s SRF data is in NetCDF format, which is portable and can be augmented easily.
* Do we need more information in files? MWSG members can look at and comment on its adequacy.

*Qifeng*

* ACTION: Robbie will grab the header from the ATMS NetCDF files and send it out to the group. Also, will send a link to the J2 SRF, so the subgroup members can download them.

**5. Subgroup Planning (Led by Qifeng and Mark)**

**A) Possible active microwave remote sensing meeting**

*Qifeng*

* Should we have another meeting focused on active microwave?
  + Misako – I don’t know, as people that may be presenting are busy.
* There is no proposal for presentation for active microwave? We can organize this? There is interest in the group for presentation on active microwave remote sensing – e.g., there is interest in active precipitation radar.
  + Misako – Colleagues are very busy, so they probably could make a presentation at some point. ACTION: Misako will talk to JAXA colleagues about giving presentation on active microwave sensing.
* CMA is busy as well. Launch of FY-4B (June) and the FY-3E launch in July.

**B) Release of FY-3E data**

*Mark* –

* For FY-3E is data publicly available?
  + Shengli – The testing lasts for one year, so data won’t be out until July 2022. For active microwave team, they are doing ground experiments for calibration. Maybe they will have time to give a talk. Next year CMA will launch Precipitation Radar.
  + Qifeng FY-3E update
    - CMA has a wind scatterometer that gives wind speed and direction.
    - The MWTS and MWHS are still under testing.
    - There is also an instrument with a day-night band. This is challenging. The terminator space environment is complex compared to night or day. The instrument has to deal with day and night in the same imaging scan. Creates issues with the technology.
    - Microwave instruments are better based on O-B.
    - For GPS receiver there is new receivers that allow twice the radio occultation samples to be acquired.
    - Hyperspectral sounder has been operating half a month. These data will be released after 3 months, but more complicated because half day and half night issue.
    - Can report initial cal/val results, but CMA management does not want it released now. FY-3E results will be delayed.

**C) Microwave Subgroup Workshop (Mark)**

*Qifeng*

* Mid-December is too soon. We need to consider the holidays and conferences
  + The second half of December is the U.S. and European holiday season. The AMS conference January 23-27. Chinese New Year is February 6-20.
  + Maybe the last week of February or first week in March (2 Days).
  + Two styles oral and poster. Poster can lead to papers.
  + Extending the meeting to groups outside of the microwave subgroup is desired.
    - ACTION: Robbie to reach out to ITOVS group.
    - ACTION: Qifeng to reach out to CEOS WGCV Microwave Working Group lead.
* A December meeting could be held that is focused on MW team status updates.
  + ACTION: Robbie to prepare an email to subgroup agency leads requesting project status updates.